

Cruise Report
NOAA Ship MILLER FREEMAN R-223
Cruise 78-1 Leg I (Jan 26 - Feb 22, 1978)
Eastern Bering Sea Herring **Hydroacoustic/Trawl** Survey

Introduction

*The main purpose of this report is to provide a brief summary of data and results obtained during the first half of the eastern Bering Sea **hydroacoustic/rawl** survey for Pacific herring being conducted during Legs I and II of MILLER FREEMAN Cruise 78-1.*

*Principal objectives of the survey are to: 1) obtain information on the distribution, abundance and biological (sex-size-age-maturity-food habits) composition of winter herring aggregations located northwest of the Pribilof Islands, 2) investigate herring schooling characteristics and **diel** behavior, and determine the species' availability to bottom and **midwater trawling**, 3) collect data on factors, including fish density and the target strength of individual fish, which affect hydroacoustic abundance estimation methods, and 4) collect CTD and/or **XBT** and other **environmental** data throughout the survey area. Other objectives are to: 1) collect ichthyoplankton samples, 2) obtain herring, pollock and **yellowfin** sole for biochemical genetic studies, and 3) collect data on pollock food habits, maturity and age composition.*

Area and Itinerary

*During Leg I the herring survey was conducted between 58° 24' - 60° 02'N and 173° 00'W - 176° 00'W (Fig. 1). Between Unimak Pass and the herring survey area **echogram** records were collected using the vessel's ELAC echo sounder, and two bottom trawl hauls were made to obtain pollock and yellowfin sole samples needed for stock **identification** studies. The vessel's itinerary was as follows:*

<i>Jan 26-28</i>	<i>completion of hydroacoustic system calibration at Pacific Marine Center, Seattle; hydroacoustic system and plankton and trawl gear tests in Puget Sound.</i>
<i>Jan 28 - Feb 4</i>	<i>Transit to Kodiak; two days in Ketchikan for inspection of vessel's main reduction gear and damaged propeller.</i>
<i>Feb 5-12</i>	<i>Transit to herring survey area with trawl sampling and hydroacoustic system tests enroute; 3.5 days at anchor due to weather.</i>
<i>Feb 12-19</i>	<i>Herring survey.</i>
<i>Feb 19-22</i>	<i>Transit to Adak; 2 days lost to weather.</i>

Survey Equipment and Methods

Hydroacoustic data were collected and processed using a van-contained computerized echo integration system. The system includes a 38 kHz echo sounder with three receivers and a towed dual beam transducer. Trawl sampling was done with an 83/112 Eastern bottom trawl and a modified Cobb midwater trawl. The latter was positioned using the vessel's up/down looking ELAC cable netsounder. Plankton and physical oceanographic data were collected using bongo and Sameoto neuston nets, and CTD and XBT systems.

Within the herring survey area the vessel ran along a trackline within a predetermined set of contiguous $1/2^{\circ}$ lat. x 1° long. blocks selected primarily on the basis of historical data on catches by foreign herring trawl fleets. The type and spacing of trackline transects was varied to adapt to observations on herring abundance and time constraints (Fig 1). Bottom trawl stations were systematically located along the trackline. Midwater trawl hauls were made on selected aggregations of echo sign. Standardized procedures were used to process trawl catches for species composition, and to obtain biological samples and data.

The hydroacoustic system was continuously operated along the trackline with the transducer at a depth of 30 m. Vessel speed varied between 7 and 10 knots. Computer system outputs (integrated echo intensities and corresponding target densities) were generated once per minute for each 10 m depth interval (or partial interval) between the transducer and the bottom, and for several bottom referenced depth intervals. The analog echo signal data were also continuously tape recorded.

Plankton stations (bongo and neuston net tows, CTD cast) were located in a manner which provided approximately one station for each 900 n.m.² in the survey area. XBT and/or CTD casts were made at each trawl station and XBT casts were made at other locations,

Results

Within the herring survey area hydroacoustic data were collected and analyzed for an 886 nautical mile trackline consisting of 30 transects (Fig 1). Approximately 6000 estimates of target density per unit surface area were made using a target strength value of -35 dB/kilogram. There was a distinct absence of herring-like and other echo sign throughout almost the entire area surveyed and this was reflected in both the uniformly low density estimates and the results of trawl sampling.

Trawl catch data are summarized in Table 1 and a list of all species captured is shown in Table 2. Only 5 midwater trawl hauls were made and three of these (haul nos. 6, 7, and 9) were made on very scattered, low echo level sign. The small catches in the other two midwater hauls (nos. 11 and 12) were quite surprising. The hauls were made at the same location on what appeared to be a series of relatively dense fish schools, and in both cases the netsounder record suggested the trawling was highly effective. A possible explanation is that the sign was almost all age 0 pollock which were not retained by the trawl.

As indicated in Table 1, herring were taken only in bottom trawl hauls.¹ They occurred in all 9 bottom hauls made in the herring survey area but catches were very small (1 to 46 lbs). Except in haul 16, they were nearly all juvenile fish with an average length of about 150 mm.

Echo sign indicative of significant schools of herring was not located until just before the end of the survey period at the site of haul 16 (Fig. 1). It was present near bottom and in midwater between the 75 and 100 fm isobaths. In deeper water (to 150 fm) on the transect where this sign was observed there appeared to be a substantial near bottom layer of pollock sign. Severe weather prevented investigation of the herring-like sign except for one bottom trawl haul (no. 16). Because of prevailing seas this haul was necessarily made along the transect and covered a depth range of 80-115 fm. The catch was mainly pollock but it also included the largest catch (in weight; 46 lbs) of herring taken during the survey. It was the only herring catch composed entirely of adult fish (average length about 260 mm). These fish were feeding heavily on euphausiids. The juvenile fish taken in other hauls all had empty stomachs.

If circumstances had permitted the survey to continue, the apparent herring aggregation would have been sampled with midwater trawl hauls and a series of closely spaced hydroacoustic transects would have been run along the outer shelf between the 60 and 100 fm contours. Assuming the echo sign can be relocated, these activities will be conducted at the beginning of Leg II.

The results of Leg I suggest that this year the distribution of herring may be significantly shifted from that which was anticipated based on historical fishery data and past Soviet research vessel surveys. In this regard, it is worth noting that relatively large amounts of echo sign which may have been herring were observed adjacent to the Pribilof Islands while enroute to the herring survey area. It is planned to spend some of Leg II surveying at least part of the area where this sign was encountered.

As shown in Table 1 bottom trawl catches of fish consisted primarily of pollock, Greenland turbot and sculpins (mainly brown and yellow Irish Lords). Tamer crabs and snails were the most abundant invertebrates taken during the survey.

A summary of herring and pollock biological data and samples collected during the survey is shown below:

	<u>Herring</u>	<u>Pollock</u>
No. lengths	318	2,409
No. scales	137	---
No. otolith~	---	705
No. stomachs examined	~ 200	290
Whole fish samples (frozen)	2	2

1 Herring (1 lb) occurred in one midwater trawl haul (no. 7) but it was obvious most, if not all, of the catch was taken when the trawl was on bottom at the beginning of the haul.

Adult pollock were found to be feeding primarily on juvenile pollock and unidentified fish.

A few squid and/or octopus occurred in six trawl hauls and all specimens were preserved for taxonomic studies being conducted at School of Oceanography, Oregon State University.

Total numbers of oceanographic and plankton stations were as follows:

CTD's.....	9
XBT's.....	14
Neuston net tows.....	7
Bongo net tows.....	7

The deviation between CTD and XBT temperature measurements usually did not exceed 0.1°C . Bottom salinities in the herring survey area ranged from $32.45^{\circ}/\text{oo}$ to $32.97^{\circ}/\text{oo}$.

Scientific Personnel

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JAPANESE BERING SEA GROUND FISH $\frac{1}{2}$ X 1 degree Statistical Blocks

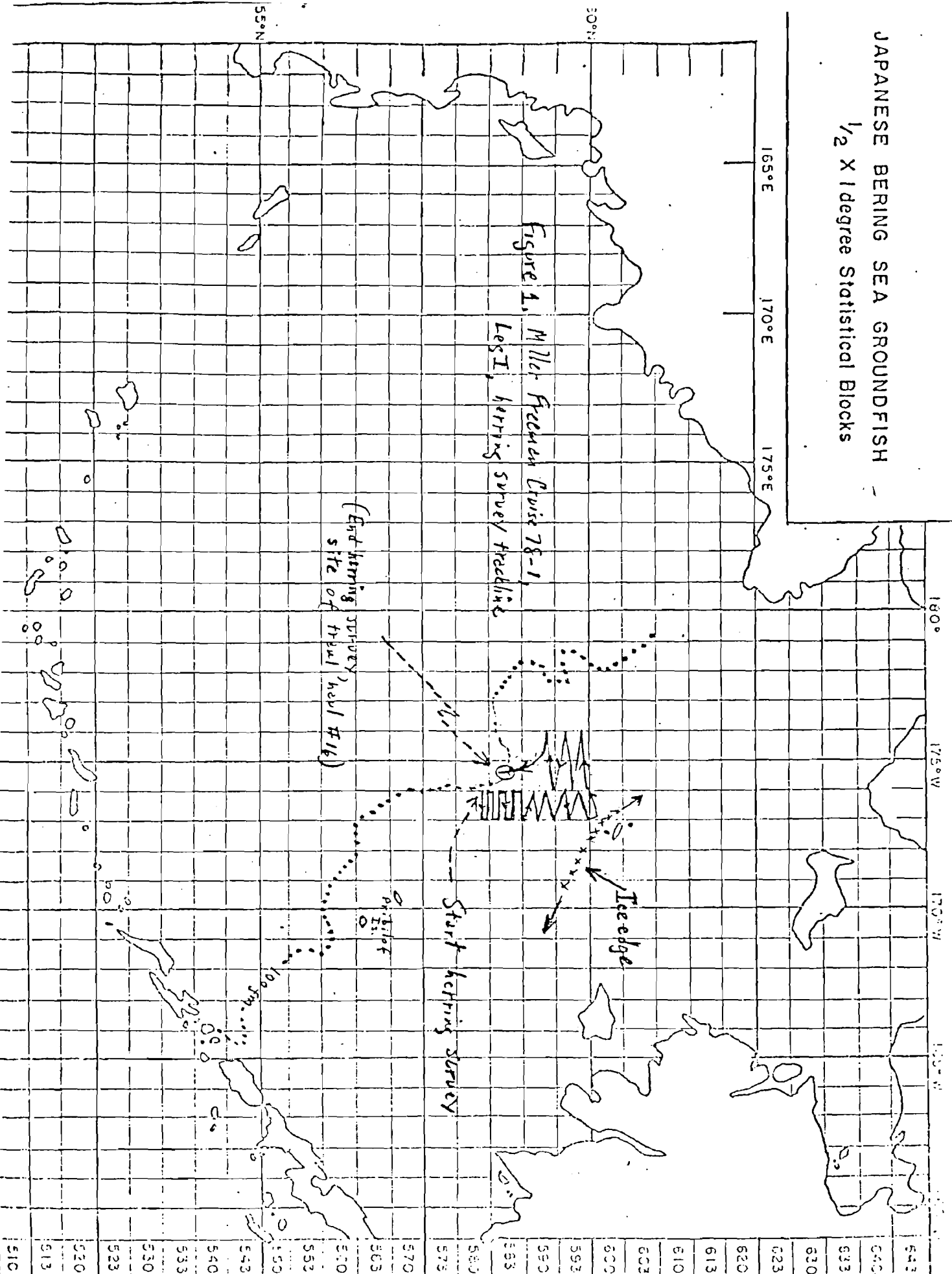


Table 1. Summary of trawl station and catch data, MILLER FREEMAN Cruise 78-1, Leg I. (Page 1 of 2)

Haul No. (Type ¹)	Date	Position		Local Time (hr)	Dura- tion (hr)	Avg. Depth (fm)		Water Temp. (°C)	
		Lat. (N)	Long. (W)			Bottom	Gear	Surf.	Gear
1. (B)	2/11	55 26	167 57	09	0.5	89	89	3.0	4.2
2. (B)	2/12	57 22	171 44	01	0.5	57	57	2.7	3.3
3. (B)	2/12	58 24	173 23	14	0.5	64	64	3.1	2.9
4. (B)	2/13	58 36	173 51	01	0.5	74	74	2.6	3.9
5. (B)	2/13	58 47	173 21	15	0.5	65	65	2.6	2.7
6. (M)	2/13	58 49	173 00	22	1.0	60	58	2.2	2.4
7. (M)	2/14	58 58	173 02	02	0.7	56	34	2.0	2.5
8. (B)	2/14	59 00	173 38	11	0.5	64	64	2.6	2.6
9. (M)	2/14	59 09	173 51	19	1.0	63	59	2.6	2.7
10. (B)	2/15	59 26	173 19	08	0.5	57	57	1.8	2.3
11. (M)	2/15	59 29	173 09	11	1.1	56	54	1.7	2.2
12. (M)	2/15	59 29	173 10	16	1.3	54	50	1.6	2.0
13. (B)	2/16	59 43	173 22	00	0.5	54	54	1.7	1.4
14. (B)	2/16	59 57	174 32	16	0.5	54	54	2.0	2.1
15. (B)	2/17	59 39	175 29	12	0.5	74	74	2.6	2.6
16. (B)	2/18	58 45	174 51	15	1.0	95	95	3.1	4.2

¹/B= bottom; M = midwater

Table 1. Summary of trawl station and catch data, MILLER FREEMAN Cruise 78-1, Leg I. (Cont'd) (Page 2 of 2)

Haul No. (Type ¹)	Catch (lbs) of herring and/or three dominant fish species	Remarks
1. (B)	Pollock (686), Pac. cod (189), Pac. halibut (10)	Haul made enroute to survey area (for pollock)
2. (B)	Pollock (122), Greenland turbot (169), Yellowfin sole (23)	Haul made enroute to survey area (for yellowfin sole)
3. (B)	Herring (2), Pollock (148), Greenland turbot (24)	
4. (B)	Herring (3), Pollock (413), Sculpins (9)	
5. (B)	Herring (23), Pollock (369), Sculpins (246)	
6. (M)	Herring (1), Sculpins (441), Pollock (42)	Trawl on bottom for 10-15 minutes
7. (M)	Pollock (8)	Remainder of catch: jellyfish (35) squid (2)
8. (B)	Herring (5), Pollock (396), Sculpins (403)	
9. (M)	Pollock (3) - juveniles	
10. (B)	Herring (7), Greenland turbot (188), Pollock (148)	
11. (M)	Pollock (1) - juveniles (age 0)	Remainder of catch: jellyfish (30)
12. (M)	Pollock (1) - 1 adult; 26 juveniles (age 0)	Remainder of catch: jellyfish (20)
13. (B)	Herring (16), Greenland turbot (314), Pollock (59)	
14. (B)	Herring (2), Pollock (7), Greenland turbot (6)	
15. (B)	Herring (1), Pollock (664), Greenland turbot (36)	
16. (B)	Herring (46), Pollock (3676), Pac. cod (338)	

Table 2. Fish and invertebrates taken in trawl hauls during MILLER FREEMAN
Cruise 78-1, Leg I.

<u>Taxa</u>	<u>Common Name</u>	<u>Scientific Name</u>
<u>Rajidae</u>	<u>Black Skate</u>	<u>Raja kincaidii</u>
	<u>Skates (unid.)</u>	
<u>Clupeidae</u>	<u>Pacific herring</u>	<u>Clupea harengus pallasii</u>
<u>Salmonidae</u>	<u>King salmon</u>	<u>Oncorhynchus tshawytscha</u>
<u>Osmeridae</u>	<u>Eulachon</u>	<u>Thaleichthys pacificus</u>
<u>Gadidae</u>	<u>Walleye pollock</u>	<u>Theragra chalcogramma</u>
	<u>Pacific cod</u>	<u>Gadus macrocephalus</u>
<u>Pleuronectidae</u>	<u>Pacific halibut</u>	<u>Hippoglossus stenolepis</u>
	<u>Greenland turbot</u>	<u>Reinhardtius hippoglossoides</u>
	<u>Arrowtooth flounder</u>	<u>Atheresthes stomias</u>
	<u>Yellowfin sole</u>	<u>Limanda aspera</u>
	<u>Rock sole</u>	<u>Lepidopsetta bilineata</u>
	<u>Flathead sole</u>	<u>Hippoglossoides elassodon</u>
	<u>Rex sole</u>	<u>Glyptocephalus zachirus</u>
	<u>Alaska plaice</u>	<u>Pleuronectes quadrituberculatus</u>
<u>Cottidae</u>	<u>Spinyhead sculpin</u>	<u>Dasycottus setiger</u>
	<u>Bigmouth sculpin</u>	<u>Ulca bolini</u>
	<u>Great sculpin</u>	<u>Myoxocephalus polyacanthocephalus</u>
	<u>Brown Irish lord</u>	<u>Hemilepidotus spinosus</u>
	<u>Yellow Irish lord</u>	<u>Hemilepidotus jordani</u>
	<u>Sculpins (unid.)</u>	
<u>Zoarcidae</u>	<u>Wattled eelpout</u>	<u>Lycodes palearis</u>
	<u>Shortfin eelpout</u>	<u>Lycodes brevipes</u>
	<u>Eelpouts (unid.)</u>	
<u>Bathymasteridae</u>	<u>Searcher</u>	<u>Bathymaster signatus</u>
<u>Agonidae</u>	<u>Sturgeon poacher</u>	<u>Podothecus acipenserinus</u>
	<u>Poachers (unid.)</u>	
<u>Zaproridae</u>	<u>Prowfish</u>	<u>Zaprora silenus</u>
<u>Cyclopteridae</u>	<u>Pink snailfish</u>	<u>Careproctus rastrinus</u>
	<u>Snailfish (unid.)</u>	
<u>Crustacea</u>	<u>Tanner crab</u>	<u>Chionoecetes bairdi</u>
	<u>Tanner crab</u>	<u>Chionoecetes opilio</u>
	<u>Pink shrimp</u>	<u>Pandalus borealis</u>
	<u>Pandalid shrimp (unid.)</u>	
	<u>Blue king crab</u>	<u>Paralithodes platypus</u>
<u>Misc. invertebrates</u>	<u>Starfish (unid.)</u>	
	<u>Sea urchin (unid.)</u>	
	<u>Snails (unid.)</u>	
	<u>Nudibranch (unid.)</u>	
	<u>Squid (unid.)</u>	
	<u>Octopus (unid.)</u>	
	<u>Jellyfish (unid.)</u>	